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POSSIBILITIES OF FORECASTING HYPERCHOLESTERINEMIA IN PILOTS

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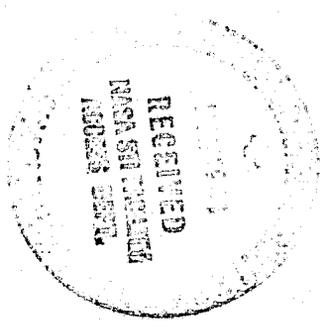

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16. Abstract

We studied the dependence of the frequency of hypercholesterinemia $\geq$ 6.45 mmole/l on the age, average annual flying time, functional category, qualification class and flying specialty of 300 pilots. We computed the risk probability coefficient of hypercholesterinemia. We developed an evaluation Table which gives an 84% probability of forecasting risk of hypercholesterinemia correctly and for approaching primary prevention of atherosclerosis in pilots.

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POSSIBILITIES OF FORECASTING HYPERCHOLESTERINEMIA IN PILOTS

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Among the various nosological forms of cardiovascular pathology, /18* atherosclerosis is one of the primary reasons for disqualification for flight.

The majority of investigators recognize that hypercholesterinemia is of primary importance in the development of ischemic heart disease (atherosclerosis). A statistical analysis of data obtained from the study of the connection between ischemic heart disease and cholesterinemia level made it possible for us to do computations which show that a reduction in the cholesterol concentration in the blood by 15% must lead to a reduction in the appearance of new cases of ischemic heart disease by 35%.

The role of hypercholesterinemia in the development of atherosclerosis determines the basic means used to prevent it. For this reason, in order to forecast the fitness of pilots for work and also to select a group of pilots requiring thorough examination and primary prevention for atherosclerosis, the cholesterol index of the blood is of considerable importance. Since biochemical investigations of blood serum are fairly laborious and involve removing pilots from flight preparation, individual hypercholesterinemia forecasting by questionnaire data without direct biochemical examination is highly valuable.

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* Numbers in the margin indicate pagination in the foreign text.

In this work we studied the medical histories of 300 pilots who underwent complete clinical examinations in a hospital in order to determine their suitability for flight. The examination included a complex EKG with functional tests, orthostatic tests, examination in a decompression chamber to determine endurance under moderate degrees of hypoxia, determination of blood cholesterol concentration using the Mrskos and Tovarek method. On a special card we recorded age, average annual flying time during the period of flight work, position, class qualification and flying specialty. The group studied was comprised basically of members of regular and alternate flight crews who received a regulated diet and who generally conducted training flights.

Nineteen percent of those examined were healthy and 12% (with anomalous refractions) were practically healthy, in 24% we diagnosed the initial stage of hypertonic illness and hypertonic neurocirculatory distonia, in 13%, functional diseases of the central nervous system, and in 9%, illnesses of the gastro-intestinal tract. In 10 pilots we found atherosclerosis; two of these suffered myocardial infarction during the intercommission period. Ten percent of those examined were determined to be unsuited for flight work, 17% were restricted and the remainder were deemed suited for flight work without restrictions.

The average cholesterol level in the blood of the pilots examined was equal to 5.68 ± 0.06 mmole/1. In Table 1 we give data characterizing the average blood cholesterol level in pilots in various age /19

TABLE 1
THE BLOOD CHOLESTEROL CONCENTRATION IN PILOTS OF VARIOUS AGES

Age, years	Blood cholesterol level ($M \pm m$) mmole/l	reliability of differences[1]
To (25 .	4,88±0,32	<0,02
26—30 . .	5,19±0,23	<0,05
31—35 . .	5,44±0,17	>0,1
36—40 . .	5,60±0,10	<0,1
41—45 . .	5,88±0,09	<0,1
Over 45 .	5,91±0,16	>0,1

groups.

The results obtained indicate a general tendency: with age the average cholesterol level in the blood increases, reaching its maximum at 45 years of age and above. In 137 of the pilots examined the cholesterol level in the blood exceeded 5.68 mmole/l and in 70% it was equal to or greater than 6.45 mmole/l. Since hypercholesterinemia $\geq$6.45 mmole/l is considered to be a factor in atherosclerosis risk, the incidence of hypercholesterinemia $\geq$6.45 mmole/l in each age group was interesting. These data are shown with the probability ratio coefficients in Table 2.

The probability ratio coefficients show the probability of hypercholesterinemia $\geq$6.45 mmole/l in pilots of various ages in comparison

1. The reliability of differences is computed with respect to the average blood cholesterol level for the entire group.

TABLE 2
THE INCIDENCE OF HYPERCHOLESTERINEMIA IN PILOTS OF VARIOUS AGES

Age, years	Extensive indices, %		Ratio of probability
	Group of pilots with hypercholesterinemia ≥ 6.45 mmole/l	Group of pilots with cholesterol level < 6.45 mmole/l	
To 25 . .	1,4	3,9	1,4:3,9=0,36
26—30 . .	4,3	7	4,3:7=0,61
31—35 . .	10	14,3	10:14,3=0,70
36—40 . .	24,3	27,4	24,3:27,4=0,89
41—45 . .	41,4	33,5	41,4:33,5=1,24
Over 45 . .	18,6	13,9	18,6:13,9=1,34
Total	100	100	

with the probability of blood cholesterol level less than 6.45 mmole/l. For example, a coefficient of 1.34 for pilots older than 45 years of age shows that at this age the risk of hypercholesterinemia is 1.34 times greater than average.

Such computations may provide the basis of individual forecasting of hypercholesterinemia. According to our data, we must consider the following factors (indices) in addition to age: average annual flight time, position, class qualification and flight specialty.

For each factor we computed the probability ratio coefficient, as

in Table 2 and then we compiled an evaluative Table. In order to simplify our computations, we used logarithms of the probability coefficients rounded off and multiplied by 10 instead of the probability coefficients P. This made it possible not to multiply but to add forecasting coefficients (FC = 10 lgP) in the following complex evaluation.

TABLE 3

AN EVALUATIVE TABLE FOR INDIVIDUAL FORECASTING OF HYPERCHOLESTERINEMIA RISK ≥6.45 mmole/1 IN PILOTS ACCORDING TO THE FORECASTING COEFFICIENTS (FC)

Age, years	FC	Probability category	FC	Classification	FC	Flight specialty	FC	Average annual flight hours	FC
Over 45	1,3	3rd rank	3,4	1st class	0,9	fighter pilots	0,9	very high	4,03
41—45	0,9	2nd rank	1,0	2nd class	—1,37	pilots of sport planes	0,04	high	3,99
36—40	—0,5	4th rank	0,6	3rd class	-1,43	pilots of transport planes and helicopters	—0,7	above average	—0,4
31—35	—1,6	directing personnel	0,3	no class	—2,7	navigators	—0,8	average	—0,8
26—30	—2,1	1st rank	—0,8	-	—	radio operators and others	—1,3	low	—1,3
To 25	—4,4	-	—	-	—	-	—	insignificant	—4,0

Thus, all of the evaluations of hypercholesterinemia risk are in the range from -4.4 to +4.03. The sum of the maximum values of the forecasted coefficients for 5 factors equals: FC_{max}= 1.3+3.4+0.9+0.9+4.03= 10.53. The sum of the minimum values of these indices equals: FC_{min}= (-4.4)+(-0.8)+(-2.7)+(-1.3)+(-4.0)= -13.2. Thus, the entire range from minimum to maximum risk of hypercholesterinemia is from -13.2 to 10.53.

In order to compute the complex evaluation of hypercholesterinemia risk, for example, for a 44 year old pilot in the third rank, first class who pilots sport planes, with a very high average annual flight time during the entire period of flight work, we should add the forecasting coefficients found in the evaluative Table. The total forcasting coefficient (FC_{tot}) will equal FC_{tot}= 0.9+3.4+0.9+0.04+4.03 = 9.27. The value of this coefficient indicates the high probability of hypercholesterinemia in the pilot. /20

For a 38 year old pilot second class who pilots helicopters with an average level of average annual flight time during the flight period, this forecasting coefficient is FC_{tot} = (-0.5)+(-0.8)+(-1.37)+(-0.7)+(-0.8) = -4.17. His risk of hypercholesterinemia is significantly lower.

Pilots may be divided into the following groups with respect to forecasting coefficients: 1) pilots in whom there is a low probability of hypercholesterinemia (FC range from -13.2 to -0.61); 2) pilots in whom hypercholesterinemia is probable (FC range from -0.60 to +1.59);

3) pilots in whom hypercholesterinemia is highly probable (FC range from $+$ 1.6 to $+$ 10.53).

In order to judge the precision of this forecasting Table we did a retrospective check with computations of the forecasting coefficients for each pilot. In only 48 (35% of the pilots with cholesterol levels in the blood higher than 5.68 mmole/l) was it not possible to forecast accurately the risk of hypercholesterinemia; this comprised only 16% of all of the pilots examined.

The group of examined members of the flight crews is relatively small. Nevertheless, the results obtained indicate the possibility of forecasting risk of hypercholesterinemia by taking into account professional factors of flight work, and consequently, the possibility of a differential approach to primary prevention of atherosclerosis in pilots.